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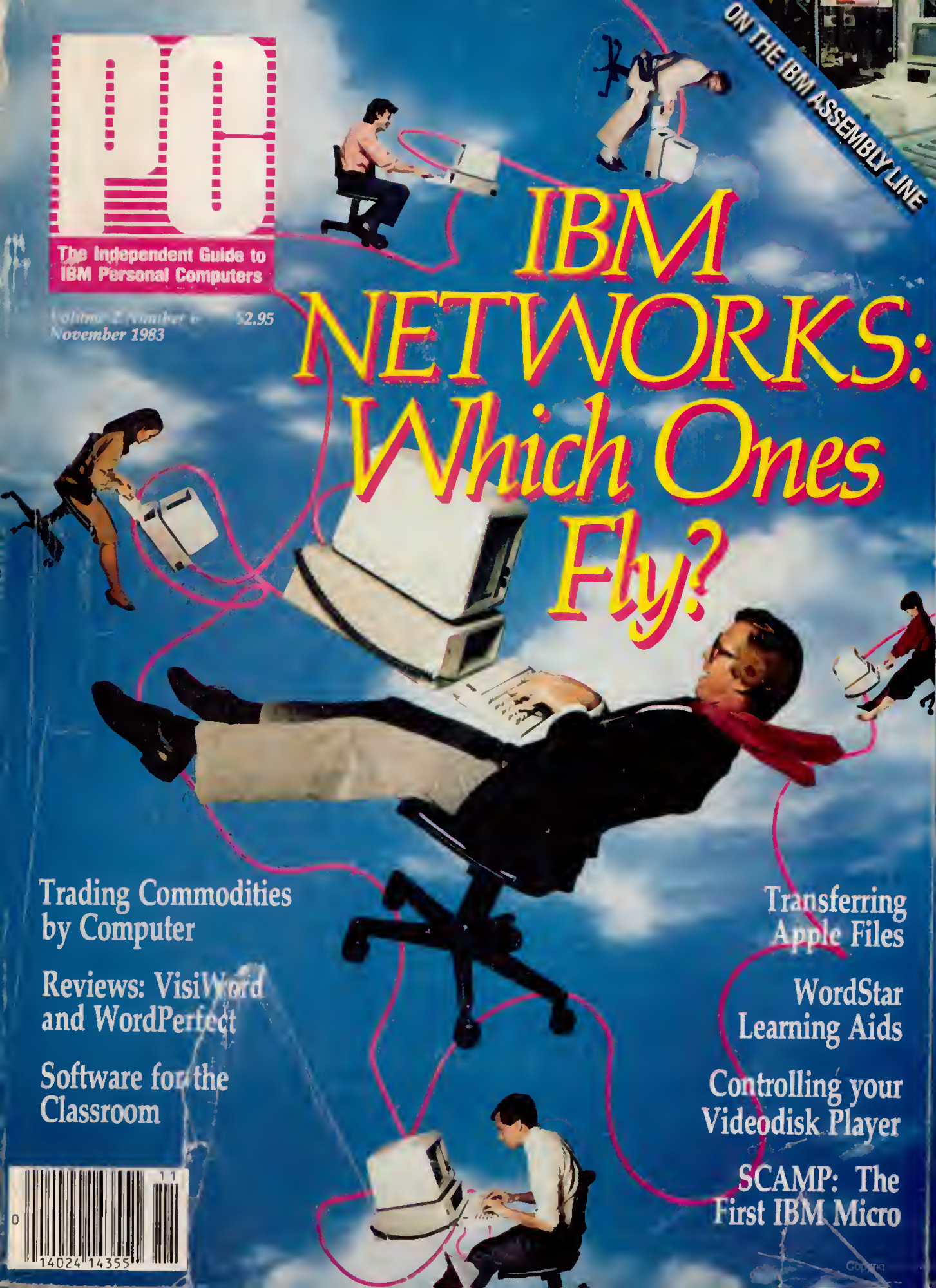

IBM NETWORKS: Which Ones Fly?

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The Independent Guide to IBM Personal Computers

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BATTLE NETWOR

NETWORKS/BILL MACHRONE

The manufacturers of networks have been sending up smoke signals to let the world know their products are ready. While it's often true that where there's smoke there's fire, you can get burned, too.

OF THE K STARS

Are you ready for networking? Here are a few qualifiers that may help you decide. Do you have several PCs and only one letter-quality printer? Do people line up at the printer to wait for their turn? Are there several PC-equipped "stations" through which work must flow? Are you shuffling disks? Is one PC user creating information to be used by others on their machines? Do you wish all your PCs were XTs or had hard disks?

If you answered yes to any of the above questions, read on; you could be a candidate for a network.

We've seen a sudden proliferation of courses purporting to teach you how to network your micros. A course? How tough can it be? For 3 days and anywhere from 500 to 1,000 bucks, you can learn everything from the history of micros to

Photographs by Shig Ikeda

network topologies to how to negotiate the contract with your chosen vendor. Maybe there's more to this than meets the eye, we figured.

We read the ads, attended the seminars, and dropped by the booths at the shows. Yet through it all, we hed nagging doubts about some of the claims being made about performance, capabilities, and price per work station. Our solution was to assemble in our offices one of every kind of network we could iey our hends on. We were tough with the vendors: "If we can't see it work on our mechines in our environment, it doesn't exist," we reasoned. The vendors were cooperative. Some sent technicians, some sent marketers, but all sent networks. Our requirements were simple: Just tie two PCs to an XT. This, we figured, was the bare minimum configuration we would want as e foundation for a network. When we actually set them up and ran them, we expected the results to be interesting, and we found more then a few surprises.

In order to test the networks, we devised s group of standard tasks that would be either real-life examples or measurements that would indicate how the networks were likely to perform in real situetions. The first thing we wanted to test was how well the network provided shared access to large, commonly used programs. These could be anything from a word processor to a compiler or s spreadsheet program. We chose *WordStar* as our benchmark for this test and measured the amount of time necessary to load it over the network from a hard disk file server.

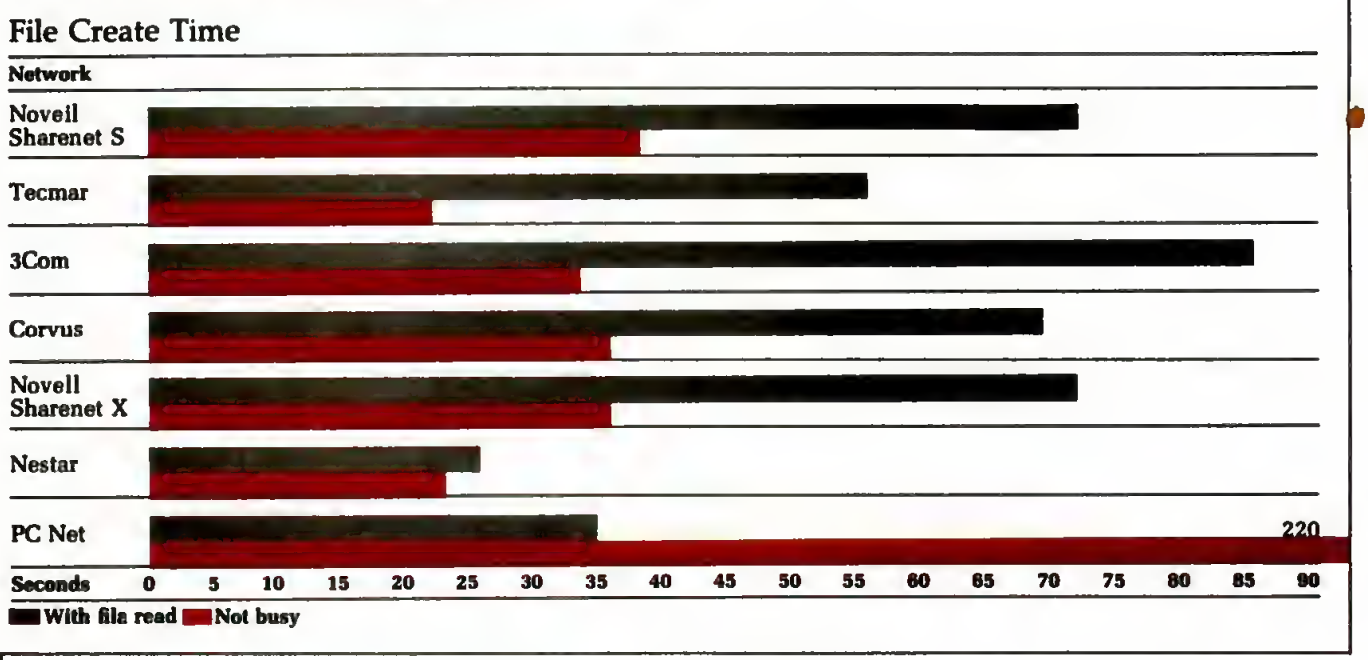
Do you wish all your PCs were XTs or had hard disks?

Our next test was to see how fast we could pump out characters from the printer part of a print server and to what extent activity on the network slowed the printer port. For this, we built an "infinitely fast printer," which acknowledged characters as fast as they were transmitted and counted the number of characters sent in 1-second or 10-second intervals. A short compiled BASIC program LPRINTed a character pattern continually.

The first of our file-oriented tests was another BASIC program, which continually created files in random access mode. Each record was 1,024 bytes long, and the file length was 20 records. We recorded the time every ten times the file was created. Another test read 20 records at a time from e file of 1K records, and here, too, we checked the time every ten repetitions.

Finally, we combined tests to see what effects they would have on each other. What constitutes reasonable performance in a network? In terms of what a file server can do, it merely needs to be faster than a floppy disk or, if speed is truly immaterial, provide more storage than a floppy disk. Can it live up to its claims? Can it share expensive resources such as fast or

A comparison of the time the netwarks take ta read a file when the netwarks are nat busy and when they are creating a file at the same time.



THE FILE server looks for all the world like a trash compactor. Inside, however, beats a heart of the purest silicon.

letter-quality printers? Can it keep them printing fast enough to be worthwhile? Speed may well be secondary. Who cares how many megabits per second a network can transfer, if it does things wrong?

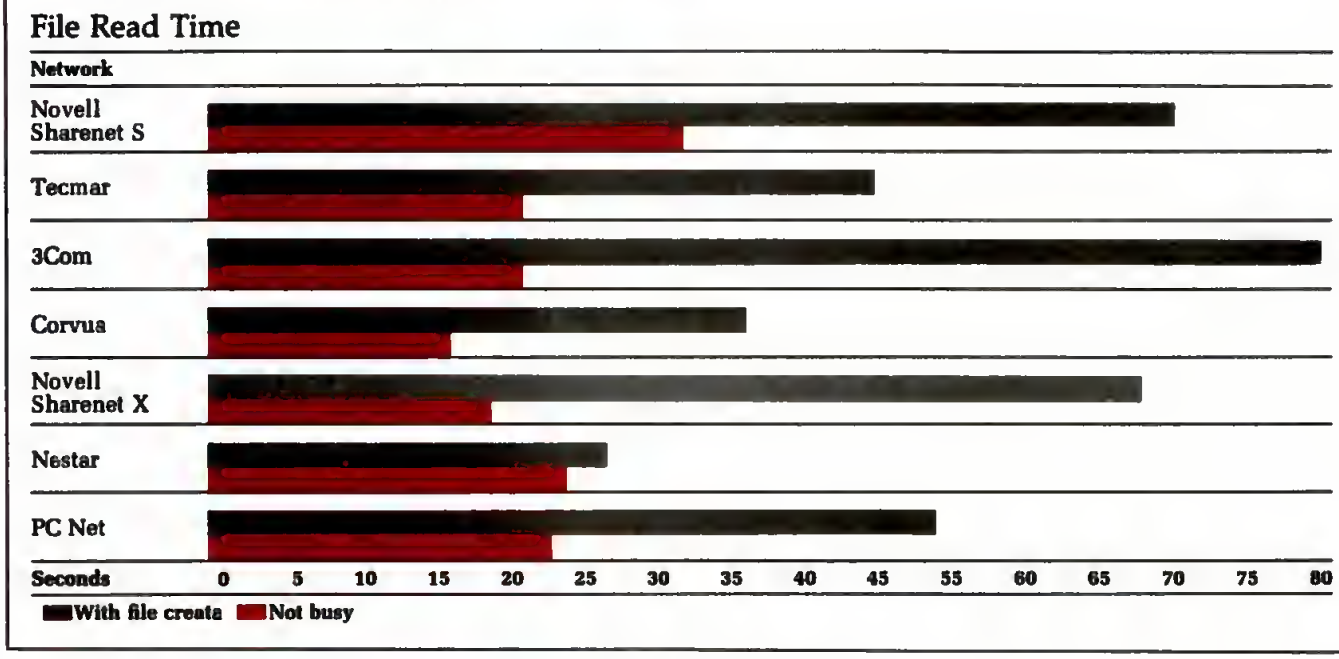
AST and Orchid PCnet

PCnet is a single product offered by three vendors. Orchid, Santa Clara Systems, and AST have a technology-sharing and cross-licensing agreement covering their network products. The network consists of a board, coaxiel cable, and software. Each board has a settable 16-bit address, so theoretically a maximum of 65,535 devlces could share the network, although more than ten may be optimistic. The stated speed of the network is 1 megabit per second, or approximately 100,000 characters per second. We did not test Santa Clara Systems' version of the network, so we will only describe functional differences where they exiat.

One feature of PCnet is that any PC can be e server or a user. In aetting up the system you specify which drives are to be private to the local user and which are to be available on the network. The file server remeins usable as a work station. Any station equipped with e printer can be a print server, since each printer is given a network ID, and there is an assignment program that allowa you to redirect your print output to eny on the network. Security is taken care of at the drive level. If you want to keep a file private, it must be on a non-network drive. There is no real provision for file aharing, other than having one copy of .COM or .EXE programs available to all users on the network. As with other networks, thet means that single-drive or even driveless PCs can be a coat-saving practicality. PCnet provides a convention for locking data files so thet they cannot be accessed by multiple users at the same time. This is usually done through batch files, which set a lock flag on a given file while it is in use and relinquiah it when the user is finished with it. Since PC-DOS doesn't provide any means of locking or sharing files, PCnet's conventions ait atop PC-DOS—an extra "layer" of checking required before a file can be accessed.

PCnet installed with reletive ease on our PCs and XT, after we removed a few cards (a modem, some combo cards, and a non-IBM graphics card), which conflicted with the interrupts used by the AST/Orchid card. WordStor loaded onto a remote PC from the XT in 2.7 seconds with no traffic on the network; the time lncreased to 6 seconds with our file read and create programs running. The file cre-

Comparing the time it takes the networks to create a file when the networks are not busy and when they are simultaneously reading a file.



ate program took 220 seconds to execute across the network, while the read test took 23 seconds. When we ran them at the same time, the write test went up to 334 seconds, and the read time went to 54 seconds.

Since PCnet modifies the standard DOS running in your PC, it slows down all operations on the machine. For example, a non-networked XT can execute the file create test in a mere 18 seconds. With PCnet running, it increases to 80 seconds, whether or not there is a communications board in the machine. There is a similar effect on the printer. Our printer benchmark, in compiled BASIC, is capable of pumping 840 characters per second out the parallel port. With PCnet running, the speed was immediately cut to 687 cps. The fastest PCnet could send printer-destined characters to another machine was 320 cps—still fast enough to keep most printers more than busy. With the file create running, there was a precipitous drop to an average speed of 80 cps. Adding the write test to the fray cut that speed by half.

A number of findings in our tests indicated that large blocks of writes to disk tend to clog the network, while reads have much less effect. We encountered a major problem in our printer test. Since BASICA and the BASIC compiler were not designed for a multiuser environment, they do things to the network that are, at best, impolite and, at worst, intolerable to the network. Chief among these offenses is the whole printer output scheme. First, BASIC doesn't go through DOS as most other programs do; it has its own printer driver. Second, it not only clears the screen when it begins operation, it also resets the printer. If the printer happens to be a shared device, and it happens to be printing, guess what? It stops. Furthermore, a BASIC program that doesn't print "hogs" the printer, since the reset and the driver make it appear that it is using the printer. Programs with better manners, such as WordStar, merely relay a message from the network control software to the effect: "The printer is busy; try again later."

WordStar and other programs like it can really be hell on a network system for other reasons. Typically, full-screen word processing programs continuelly ask DOS whether you are pressing a key. If the machine on which you are running such a program is being interrupted by a network program, you undoubtedly will notice a deterioration in performance.

IT WAS pretty amazing to see this kind of performance over two rather ordinary pieces of wire.

AST and Orchid recommend use of AST's SuperSpool and SuperDrive spooler and RAM disk software in conjunction with PCnet. While these programs speed things up and lessen printer contention, they make the network a bit more "fragile" and more confusing to set up and operate. In addition to real drives, you also have the option of sharing RAM drives, and you have to remember which is which, especially if you are sharing memory between multiple RAM disks and spoolers. Typical of all the networks in our test, network drives are assigned over and above whatever you have defined in a local machine. So on a normal PC, if you have only the two floppies, the first network drive will be C: On an XT, however, the very same drive is likely to be D:. If you have defined one or more RAM drives on the machine, the first network drive goes further in the alphabet.

Santa Clara Systems offers a Network Cache unit for use with PCnet. It consists of a small expansion chassis, which sits above or below a file server PC and contains from a quarter megabyte to a megabyte of error-correcting memory. It buffers disk accesses, which, according to the manufacturer, increases the speed of some operations by a factor of 10. The error-correcting memory reportedly scans the entire memory several times per hour, checking for and fixing soft memory errors, without interference with normal operations.

A side effect of PCnet's design is that it's hard to get anything done on the server if others are using the disk. The server's network board, of course, interrupts the server's program every time something comes across the network. Given the time it takes to fulfill the response and get back to the task at hand, things slow to a crawl. This phenomenon is virtually unavoidable in collision-detecting networks and raises questions regarding the validity of a file server (at least one as slow as a PC) also running application programs. Santa Clara Systems' Network Cache option would lessen this problem, since accessing data in the buffers would be far less taxing on the file server than a full disk access. Along these lines, AST recommends that programs using overlays be copied down to the user station in their entirety to maximize performance. This presupposes sufficient memory in the local machine to hold it in a RAM disk. The combination of write time and potential lack of room on a floppy makes this alternative unacceptable, and it violates the purpose and spirit of networks.

AST has a new electronic mail package in the works, which was not available when we tested the network. Also, both AST and Santa Clara Systems are working on a multi document spooling program, which will be ready by the end of the year. This should eliminate any bottlenecks associated with the printer, but we don't know how it will address the reset problem while in BASIC.

PCnet has one nice, rather unique feature: the ability to run jobs remotely from another PC on the network. While such a function may have limited use, it has been developed to such an extent that the slave PC sends a signal over the network when the task you assigned it is complete.

Nestar PLAN 4000

Nestar's network system is noticeably different from virtually every other system

we tested. The heart of the system is the file server. In its sober gray vertical cabinet, it looks for all the world like a trash compactor. Inside, however, beats a heart of the purest silicon. A 68000 with 256K of memory takes care of network administration tasks, while a 60-megabyte Priam drive (the smallest available; you can go over 500 megabytes) stores your files. Topping it off is a cartridge tape drive that backs up the hard disk in 20 or 45 megabyte increments. PLAN 4000 permits as many as 255 PCs to be connected to a file server, either directly or through a concentrator. The network speed is stated at 2.5 megabits per second. Nestar's network is of the token-passing variety, meaning that each device gets its chance to speak in turn, without interruption.

Our first test yielded a 2.6-second load time for WordStar when the network was quiet, and which rose to 4.2 seconds when the file create and read tests were running. We added a third PC to the fray and had three copies of the file create program running at the same time. This only slowed WordStar to 5.0 seconds. The file create time was a quick 24 seconds, which increased to only 26 seconds when the read test was running. The read test took only 24 seconds by itself and 25 seconds while the create was running.

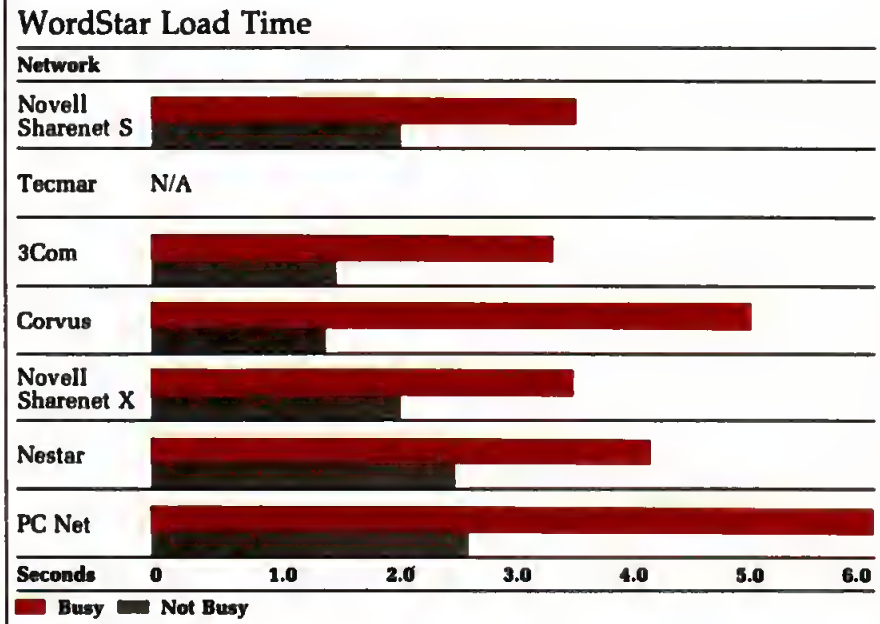
The speaker on the PC "ticks" to indicate that communication is occurring between your PC and the file server; so, even in lengthy data transfers, you know that something is happening. A unique feature of Nestar's system is that it is not limited to PCs. It supports a large variety of microcomputer operating systems, including Apple II DOS, Apple SOS, CP/M, and others. Thus, many different kinds of machines can utilize the file server and share system resources. The print server software for the PC was in beta test at the time of our trial, so we didn't get a chance to wring it out. There is a fully developed print server for Apple, and the PC system will work the same way. Our impression of the Nestar is one of quality—albeit expensive—workmanship and high performance. The degradation curve appears to be rather low, meaning that this server can tolerate heavy activity from many users without becoming objectionably slow.

Features abound on the file server. It requires a terminal for operation and needs to be brought up and shut down each day. Operation of the server requires a bit of training and expertise, as there are commands to monitor the file system, backup files, create users, set read/write permissions, and a host of other features. File protection and sharing provisions are good, and there is a sophisticated electronic mail program. Any machine in the network can use electronic mail, regardless of its make, providing a vehicle for interbrand data transfers. Another neat feature is that the PLAN 4000 can act as a gateway to mainframe systems by installing the optional 3270 communications device in the file server. The documentation is in two thick volumes, one for the server and one for the user stations.

Corvus Omninet

Corvus is the grand old man of this test, claiming to be the largest networking company in the world, based on the number of user stations running under their software. We believe them. They were on the scene early with a file server that could tie Apples or S-100 machines together over a ribbon cable to a host hard disk. They also came up with an innovative backup system for hard disks known as the Mirror, which uses a videotape recorder as the storage medium. Today, they use twisted pair cable for the network, unlike all the others we tested. Still, it pumps 800,000 bits per second across the line and uses a collision detection scheme to keep everyone communicating. Just to be sure that we got the point, Corvus sent us 1,000 feet of twisted pair cable, four IBM interface boards, and a bunch of network connectors (or taps). Installing a Corvus network entails cutting and stripping the cable and

A comparison of load times for WordStar *when the networks are busy and are not busy.*



lnserting the wires into the tap boxes. You then plug each PC into a tap box. Corvus' manual says they even supply e wire stripper, hut we didn't receive one. The Corvus cahle looked less substantial than the co-ax, hut it was just es effective. The only drawback we were able to detect was radio frequency emission from the cahle. It was weak but clearly detectable on our oscilloscope and could be heard in a radio if placed near the cahle. The co-ax, of course, showed no such effect. If we were installing a Corvus network, we would prefer to use a more expensive shielded cable, desplte the weakness of the radiation. The shields would have to be connected together in the tap boxes, hut we think it would be worth the extra effort. Actually, though, it was pretty amazing to see this kind of performance over two rsther ordinary pieces of wire.

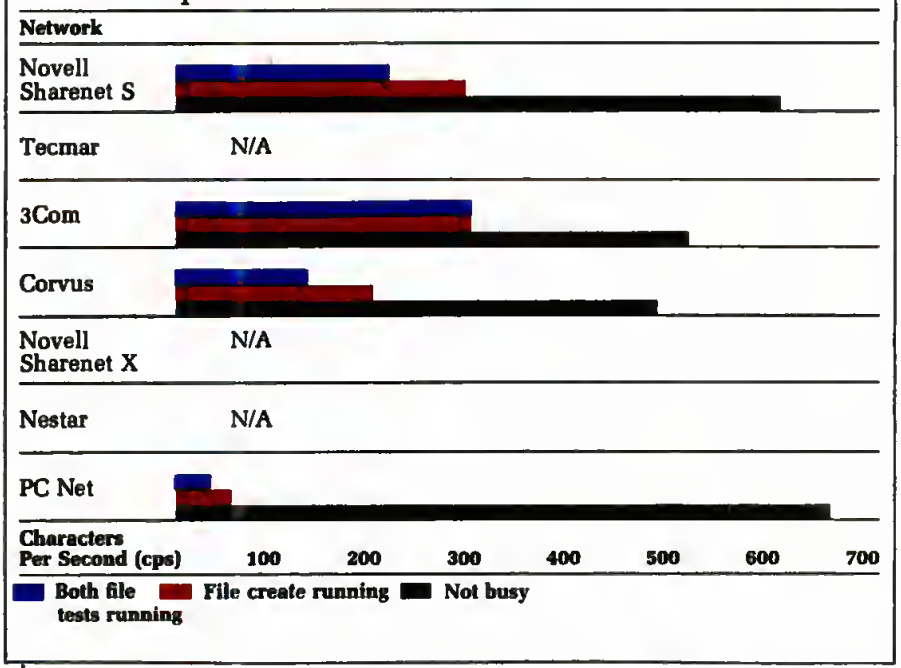
Corvus' file-locking technique is similar to PCnet's. There is a semaphore, or flag table, meinteined by the file server, and the Corvus-modified BIOS consults it before opening files for read or write. You can set up e read/write permission scheme on a per-drive basis.

Corvus' spooling technique is a hit different from that of the other systems. There is a reserved spool area on disk end a utility program sets up "pipes" to steer printer output or files to the spool area. It stays there indefinitely, until you invoke the despooling program from one of the user PCs on the network. You can specify which queue or pipe to read from, and it is then redirected over the network to the printer on your PC. Alternetively, you can start the despooler and it will wait patiently for files to show up in the print pipe, printing them as they arrive. This makes a PC a dedlcated print station, hut you can easily lnterrupt the despooler at any point, use the PC for other tasks, and return it to printing when you are done. Individual PCs cen, of course, print locally without spooling the output. An interesting feature of the spooler is that lt uses compression techniques to reduca the size of the files in the spool plpe.

There is an optional electronic mail system produced hy a third party vendor for use on the Corvus network. While we didn't have the chance to wring it out in our test, we understand that lt is a competent package and will be the basis of PCnet's electronic mail system as well.

3COM'S software provides nifty page divider sheets separating one user's output from another.

A comparison of the speed of printer outputs (characters per second) when the networks are not busy, when they are creating o file and when they hove both file tests running.



3Com EtherSeries

The only true Ethernet system in our test is 3Com's EtherSeries 3Com is the Ethernet company. Yes, Xerox has the name and the patents, but 3Com has all the big guys who developed it at Xerox. In eddition to e host of products that cover Ethernet applications from mainframes down to pieces of cahle, lt offers PC-oriented systems in two flavors: one that uses a PC-XT as a dedicated file server and one that uses an Altos 588 as the server. We chose the latter for our test.

The Altos 588 taken hy itself is an impressive machine. In its normal guise it is a five-user system with an 8086 running at 10 MHz, half a megahyte of memory, 10 or 30 megs of hard dlsk, Xenix operating system, and it's fast. 3Com's version is set up as a dedicated file and print server, with the Ethernet drivers, electronic mail, file system, and print spooler all running as tasks under Xenix. For file integrity and security reasons, no users other than the monitor terminal and the Ethernet tap are permitted on the 588. While the software

is capable of handling 100 users, the reasonable number is probably somewhere between 10 and 40, based on the mix of tasks. We tested the 10-megabyte version of the Altos. The 30-megabyte version's hard disk is about twice as fast. You wouldn't see all that much difference in maximum throughput, but the degradation curve would necessarily be lower in the server with the fester drive.

Having a system with real Ethernet rather than an Ethernet-like protocol has important implications. You can hook it up to anything that is supported by Ethernet communications. This means larger computers or entire computer networks, plotters, laser printers, word processors—the works. That's not to say that you plug in a piece of coax, and ell is bliss. You still have to consider protocols, passwords, and compatibility, but the potential is there.

3Com's print server is different from the others. Print spooling and output are done from the file server, the Altos 586, in a minicomputer-like manner. It provides e serial port to drive the printer at rates up to 9600 baud. A potentiel drawback if you already have an investment in PC-compatible printers is thet you can't hook them up to the file server, since they use e parallel interfaca. Your only recourse is to get a serial to parallel protocol converter.

The operation of the spooler, interfaca considerations aside, is quite good. Its overall speed drops slightly as the network becomes busy but stays about the same from that point on. It is similar in many ways to the performance of the Altos when running straight Xenix in multiuser mode. As you can see from the chart, the maximum speed we got over a 10-second interval was 540 characters per second; these actually are bursts at the full 9600-baud rate. That's more than enough to keep all but the festest printers going full tilt. Ditto for the 320 cps throughput rate when the network was loaded. 3Com's software also provides nifty page divider sheets separating one user's output from another—very professional.

3Com is working with a number of software companies on products that will fit into the network environment better than the current crop. A database manager derived from d*Bose II* is one, and the entire Visi-series is another. Developments such as these will move networks from being merely convenient to indispensable.

Novell ShareNet X

Novell, like 3Com, produces two PC-related network systems. One, ShareNet X, uses e PC-XT as a dedicated file server, with a network based on Ethernet. The other product, ShareNet S, uses a 88000-based dedicated file and print server in a star topology. Unlike Nestar's PLAN 4000, it uses a multiwire cable to exchange data with the user stations. We'll look at ShareNet X first.

In contrast to PCnet, ShareNet X completely occupies the file server PC-XT.

THERE are few operational differences between ShareNet S and ShareNet X.

The only functions you can execute on the host are network status and a few file server-oriented utility programs. At the time we tested ShareNet X, the print spooler was still under development. Therefore, our tests were limited to file server functions only. Like most of the others, Novell's systems require a modification to PC-DOS on the user stations. It intercepts only those calls having to do with disk drives defined as network drives and passes everything else through to your system.

ShareNet X boasts a 1.4 megabit per second deta rate and uses some sophisticated buffering techniques on the XT for speed. For instance, *WordStar* takes an agreeably quick 1.8 seconds to load across the network. If you exit and load it again without having done anything else, it loads in only 1.2 seconds—with no disk accesses. It has been buffered in a memory cache on the host XT. We found that it would buffer up to 64K, resulting in some dramatic throughput gains for small or moderate-sized files. The disk caching, combined with a few other nifty techniques, was a clear indication that Novell knows its wey around an operating system. indeed, maybe it should have written DOS 2.0. The utility programs ere UNIX-like, providing the gamut of user and file administration functions. ShareNet comes with e neat little programming tour de force called *Snipes*. It's e classic game in which your character can cruise through a maze, where it shoots a variety of objects and critters. The difference is that when two or more of you play it on the network, you're in the same maze. There you are, happily blasting everything in sight when another user's character glides into your maze and blows you to smithereens. The network version of *Snipes* runs on monochrome monitors and, in addition to being fun, is indicative of the wey deta can be shared among multiple stations, given the right programming.

There is an optional electronic mail subsystem, which provides the usuel message storage for users and has an "urgent" feature that alerts a user to important messages. Quite a bit of attention has been given to security provisions on ShareNet, steering users to certain drives, directories, and files. As with UNIX, a user may belong to e group and have all the privileges of the group automatically, while maintaining private files that the rest of the group does not have access to.

Novell's system monitor, the visible portion of the program that operates on the file server XT, is well thought-out. It shows the activity of up to six PCs and gives continuous informetion on network activity and the number of disk I/Os pending. While some of the information might be described as a little "gee whiz," it certainly keeps you informed.

ShareNet appears to be as strong a foundetion as any, given the number of

extensions to DOS thet can be celled by e programmer writing epplicetion programs. It permits the full renge of multiuser functions, including fiie and record locking, security levels, end hierarchical directory nevigetion.

Novell ShareNet S

For networks thet look so different physically, there are few operetional differences between ShereNet S and ShareNet X. Like PLAN 4000, ShereNet S uses e 68000 to run the file system. Unlike PLAN 4000, there is elso a Texes Instruments 16-bit microcomputer chip for every two users hooked up to the network. It provides sufficient intelligence thet communicetions can be overlepped among stetions, raising the overall effective speed beyond the nominal 500,000 bits per second on eech line. Remember, ShareNet S is a ster configuretion, with e direct line running from every device on the network to the server. All user-to-user communicetions go through the server. You can increese the capecity of e ShereNet S server in increments of six users et a time to e maximum of 24. It uses e terminal, like 3Com and Nestar.

As you can see from the charts, the per-

Definitions for Networks

An explanation of networking terms that appear in the article.

When we sey network, we are referring to e generic means of hooking machines together. There are two mejor types of networks: collision-detecting and token-pessing. The former is the idea on which Ethernet is based; thet is, each machine on the network has an "address" or code to which it responds. Any mechine can send e message (of standard length and formet) to any other mechine on the network. The recipient of the messege replies with en ecknowledgment to let the sender know thet the message got through okay. If two devices ettempt to transmit et the same time, e collision will result, forcing eech device to retransmit. Each board pauses e brief, random amount of time before retransmitting, minimizing the chance of enother collision. Each board listens for a carrier signal before transmitting, indicating thet no other user is on the network, evoiding unnecessary collisions and retransmissions. Since the speed of the network is usually a million bits per second or higher, collisions are not a big consideration in network performence. Even on busy Ethernet systems, it's unusual to heve more than e few collisions a day. The formel name for this routine is CSMA/CD, for Carrier-Sense Multiple Access/Collision Detection.

Token-pessing networks ere based on e device or centrel computer that supervises the network, giving eech device permission to send information. There are no collisions, since no two devices cen transmit at the same time. Token-pessing network supervisors usually ere capeble of balancing the load on the network by telling e very busy sender, "Shut up for e while and let somebody else talk." Neither type of network is limited by the speed at which it cen transmit cheracters, but e megabit (one million bits per second) is typical, and 10 megabits is the maximum you're likely to see. The Ethernet standard covers networks with e speed of 1 to 20 megebits per second.

A network user is a station thet uses the resources of the network. An example is e PC with only a floppy disk end no printer. A network server is a device or station that provides resources to the network. There are two kinds of servers, dedicated end shared. A dedicated server mey be e PC-XT, which is unuseble except by the network. Some vendors provide non-PC computers es dedicated servers. Shared servers also mey be used es computers, even though their resources ere shared by other machines on the network.

A file print server provides only hard disk to the network. It may be dedicated or shared.

A print server is a stetion that provides printing fecilities to the network. It is shared, by definition, end mey be part of the file server.

Print spooling is speciel software that coordinates and controls printing on the system. It stores charecters heeded for the printer, on disk or in memory, much faster than the printer could actuelly eccept them, releesing network users far faster than if they had to weit for the printer. The softwere then directs the characters to the printer or holds it to be despooled by e user.

You'll see the word node just ebout everywhere but here. It meens any station on the network, whether it is a user, server, printer, or whet heve you. Its vagueness makes it useless.

Topology is another good networking word, e favorite of uninformed salesmen. It describes the way in which all the devices on e network hook up to one enother. Most of the networks you will encounter are based on bus or star topology. Bus networks are simply e transmission medium (coaxial cable, fiber-optic cable, or twisted-pair ceble) that runs from one device to the next, in no particular order. Ster networks have e separete line running from every device on the network to e network controller or file server.

—B.M.

formance of ShareNet S was slightly worse than ShareNet X for tasks thet did not stress the file server heevily. There were strong indications, though, thet an XT-based network would be hopelessly bogged down in work that the 68000-besed server would take in stride. Once again, the degradetion curva becomes important as network loeding increeses.

Operation of the network from the file server is similar to ShareNet X, except thet there are edditionel commands to handle the print spoolar. In operation it is similar to 3Com's, except for additional features such es changing the priority or order in which spooled documents will be printed. From the user's point of view, there is no differenca between ShareNet X end ShareNet S. An interesting feeture of the ShareNet S intarfece boards is that they contain a bootstrep program in read-only memory. PCs without eny disk drives can thus usa the system as intelligent terminels.

Tecmar

Yes, Tecmar has a network, too, and you've been hearing ebout it for months. At press time, it was just coming out of the leb. Tecmer uses 3Com's communication boards, but shares little else with the 3Com system. Insteed of concentrating on tha minicomputer-like functions axemplified by most of tha othar networks in this article, Tecmar chose to exploit other cepebilities of Ethernet and some of thair other technologies. Basically it has combined voice and data on tha sama natwork and integrated it with telephone control hardware and software. The result is e uniqua communication system, ona that naarly defies classification.

Tha big naws with the Tecmar systam is that not only can you send voice communications over the Ethernet ceble, but you can digitize it, store it, and pley it back. At the most triviel level, this means that you can make a PC into the world's most expensive phone enswering mechine. At the othar and of the scale, it is the foundetion for a sophisticated phone and communication management system. You can record a voica messaga on disk (4,000 bytes per second of speech) and send it to one other person or en entire distribution list. It cen pley prerecorded messages end record responses for leter pleyback. The digitized sounds can be anelyzed or processed to modify the sound. Mostly, though, you'll just want to retrieve them and pley them beck over e speaker or telephone. The design criterion wes for speech quelity thet sounded es good es normal telephone conversetion, and Tecmar hes echieved that and. The Ethernet companion board, as it is called, permits ettechment of e tepe recorder, footswitch, end e few other goodias, in eddition to the telephone. Indeed, it can become your telephone, with only the handset plugged into the companion board. The software will diel, record phone usage, time calls, and figure out charges. The voica messeging system is truly a store-and-forward design, es tha messagas can be moved easily among PCs in the network.

THE TECMAR system is the foundation for a sophisticated phone and communication management system.

In terms of more treditional networking activities, we caught Tecmar e little eerly in the design cycle. The softwere wa testad was capebla of moving deta from ona mechine to enother, but full file-and print-server subsystems were still in beta test. We were, however, able to simulate our file reed and file creation benchmarks on the network to test its speed. It proved to be fest, executing the file creete test in 23 seconds, while the phone manegement software was operational (but not busy) in the host PC. While we look forward to wringing out a full-blown data and voica network from Tecmar, the data portion has taken e back seet to voice. While it eppears that their system will heva the same functionelity es everyone else's, we will have to wait and see. Tecmar's use of the 3Com board would seem to guarentee full compatibility with Etharnat—a potential advantege.

In this new, nontraditional network epplication, voice messeging, Tecmar may very well heve e tiger by the tail. We've used some mainframe-based voica messeging systems, and Tecmar's eppears to be every bit as flaxible—more so, if you hava or will have an in-housa PC network.

Documentation

There wes greet disparity in the quality and emount of documentation eveileble with networks. 3Com's was the best, end, while there wesn't e "worst," PCnet's documentetion could heve been more deteiled end bettar developed. For instance, in order to use the low-level file-locking protocols availeble from PCnet's BIOS, you heve to request the documentation for that feature from AST or Orchid. There were minor differences in the AST end Orchid versions of the documentation, with the nod for quality going to AST. Only two of the vendors' manuals discussed interrupts and the potentiel for conflict, and only one of the two gava eny suggestions on what you could do about conflicts.

Corvus' documentetion, while brief, covered whet needad to be seid and did it succinctly. It ectuelly want into e feir bit of detail on things like dealing with medie defects, programming with semephores, and even configuration for propar oparation with programs lika *Visicalc* and those from the Peachtree eccounting serias.

We mentioned Nestar's two thick volumes. If they had been typeset instead of typewritten, they would be two modarate volumes or one thick volume. The eppearanca of the Nestar documentetion is not up to the leval of professionalism so evident in its product. The contents, however, are just fine. The documentetion is nicely broken down into usar-oriented and system meneger-oriented chapters.

Part of the ponderousness is due to the inclusion of the non-IBM operating system options as well as PC-DOS. There's a fair bit that could be eliminated from this manual for a PC-only network.

Novell's manual is typewritten in a large three-ring binder. It covers everything from physical installation of the system to use of the extended DOS calls for multiuser operation. We were able to review a proof copy of new documentation on the way to the typesetter. It looked even better than the original—more tutorial and detailed.

We said that 3Com's documentation was the best, and it is. It covers all that you need to know about installing and using the product, including some how-not-to's and what to do about it if you've done it wrong. The manual is typeset and index tabbed, with good illustrations where appropriate, something that most of the others lacked. Corvus had the only other manual with effective illustrations.

Conclusions

Throughout this article, you've read the words *new, developmental, beta test, coming soon,* and *under development.* Our purpose was to separate the smoke from the fire, and there is no doubt that there is a bit of each in networking. You've seen what we've seen—everything from promises to products. Several manufacturers wanted a full mention in this article based on specifications of forthcoming products, anywhere from 2 weeks to 4 months away from introduction. Sorry, guys. Reality was required to make the team. We grant you that this market will be considerably more mature 6 months from now, but one thing will remain the same: it will be divided between those companies that have their acts together and those who don't. We were frankly surprised that the market is as good as it is, this early in the game.

THE appearance of the Nestar documentation is not up to the level of professionalism so evident in its product.

We didn't really have to call for help in installing any of the systems, but then we're not neophyte PC users. Based on the overall level of documentation, we recommend that if you're interested in networks that you pursue them through a dealer. Indeed, most of these products are available only through dealers. That's to your advantage; you have someone to hang it on when it doesn't work the first time.

Performance numbers: how much do they really matter? One of the networks we tested was clearly the fastest, another undeniably the slowest. Did that make one the winner and the other the loser? We called some users of PCnet, the slowest in our test, to find out if performance was a problem.

None cited speed limitations as an

Network	Type	Dedicated File Server?	Terminal Required?	Print Spooler?	Printer Type	Other (Nnn PC) Operating Systems?	Security 1-Poor 5-Excellent	Ease of Installatinn 1-Difficult 5-Easy	Cost: Board / Server
PC Net	CSMA/CD	No	No	Yes	Par.	No	2	2	$695 / N/A
Sharenet X	CSMA/CD	Yes (XT)	No	No	—	No	4	3	$595 / $4995 (XT)
Sharenet S	Token	Yes	Yes	Yes	Ser.	No	4	3	$250 / $8785 (20MB)
Nestar	Token	Yes	Yes	No	—	Yes	4	4	$595 / $19,995 (60 MB)
Tecmar	CSMA/CD	No	No	No	—	No	N/A	3	$1645 (Voice) $950 / $4995(XT)
3 Com	CSMA/CD	Yes	Yes	Yes	Ser.	No	5	4	$950 / $12,500 (30 MB)
Corvus	CSMA/CD	Yes	No	Yes	Par.	Yes	2	2	$495 / $3985

MB-megabytes

Considering Cost Effectiveness

When it comes to networks, the price tag depends on more than the cost per work station.

You've decided to buy a network, and you've read all about each system's capabilities and limits. Now you want the bottom line: the best network for your money. For all the networks, cost-per-user levels off at about nine work stations. The seven networks divide into two basic price ranges. Keep in mind that our prices are rough figures and do not include the cost of wire and some utility software.

The lower-priced networks include PCnet, Corvus, and Novell's Sharenet X and S. Obviously, PCnet is the least expensive network, provided you can live with the system's limitations. Although Novell's Sharenet X and Sharenet S basically performed equally, you must remember that the X system is limited to six users. If you have more work stations, the Sharenet S network is better in terms of price and capability. However, the Sharenet X price includes a PC-XT for a server. The Corvus is cheaper than either Sherenet system and has the extra advantage of accommodating different microcomputers, such as the IBM PC and Apple. The only other network that offers such flexibility between microcomputers is Nestar, the most expensive system we tested. Corvus uses twisted pair cable, which is about one-fifth the price of coax.

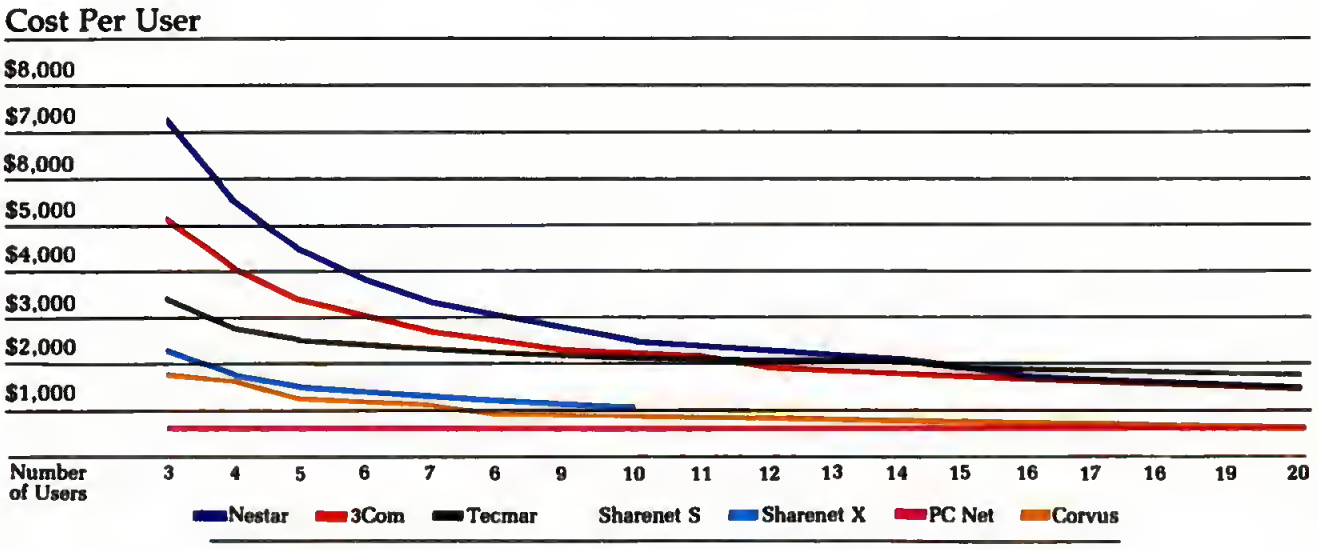
Nestar, along with Tecmar and 3Com, are in the higher price range. Nestar remains the most expensive network. However, it includes the largest disk and a tape backup and the price becomes competitive when there are 13 or more users on the system.

The price from 3 to 20 users does not vary much for the Tecmar network. The big advantage of the Tecmar system is its capability for voice digitization. Further, the Ethernet companion board for this function is included with each machine. The price quoted in the chart for the Tecmar system also includes an XT server (not dedicated), since we can't imagine using this network without a hard disk. You may prefer Tecmar's expansion chassis and hard disk as an alternative.

The 3Com EtherSeries, which is priced between the Nestar and Tecmar, has several advantages that justify its price. It is the only true Ethernet system, which makes it compatible with many other Ethernet products. The system also has great flexibility, because it is fast and can accommodate many users. The system also has numerous powerful utility programs.

The advantages and disadvantages of each network must be weighed against price. The bottom line is that the least expensive system may not be the one for you.

—*Lisa Ellen*



ohstacle. One user, who was usiog dBose *II* across the network (although not in multiuser mode) liked the ease with which it could be accessed from any terminal. She had set up the recommended batch files to lock data files in use, and while the process was a little unwieldy, she found it effective. Most users liked the low cost of PCnet and because of It, were willing to live with Its other shortcomings. One user cited difficulty of instellation, mentioning conflicts with other boards in the system using the seme Interrupt.

We found this to be a prohlem with network boards as e whole, not just with PCnet's. There are precious few interrupt lioes aveilahle oo the PC, and there is no agreement on which menufacturers or functions will use what line. Expect some prohlems if you have verious multifuoction boards in your PCs. Expect more prohlems if you heve the older, 64K system board. Oh, you'll get it to work, hut you may wind up disahling COM2: or some such thing on the system. Another problem that surprised us was the poor quality of coaxial terminations on all but the 3Com cables. After experiencing some flaky behavior, we hooked random pieces of co-ax, supplied hy the manufacturers, to the oscilloscope and a signel source. We found lousy, attenuated cahles, bad joints, and general junk. Overall, the quality was bad enough that we couldo't single any manufacturer out es a culprit. Maybe these cables have been to a lot of shows and have been ahused, hut we didn't expect them to be this bad. In any case, they are something for you to look out for If you find yourself in the market.

We were glad to hear that 3Com is supporting the efforts of software houses to produce network-competihle products, such as database managers and spreadsheet programs. Douhtless, other network vendors will follow suit. We fear, however, that such efforts are doomed to repetition, if not to feilure. MS-DOS is not e multi-user operating system. Each network vendor adds his own extensions to it, and the software authors must conform to these extensions. Perhaps the next release of DOS wiil have muitiuser extensions that remove the dependeocies on oonstandard DOS calls. Maybe there even will be e standard way to recognize and integrate calls to a nonlocal resource, such es Digital Research's CP-Net or some of the distributed processing schemes found on minlcomputers. Until theo, distributed detabases will be unlikely, and you may have to buy your database manager and other software from the network vendor or his deeler if you went full utility.

There are large disparities in the effectiveness of security provisions on the various networks. Some, like PCnet, are strictly for people who like each other and understand the wey things work. Corvus' protection scheme is in the same league, meyhe half a step up. The big boys in file protectioo—Nestar, 3Com, and Novell—are all very minlcomputer-llke, with security provisions that most resemhle VAX VMS or UNIX. The system administrator bas complete control over group and user permissions, use of system facllities, and the like. Users are adequately protected from one another and from themselves. These high-end systems, especially 3Com and Novell, elso have the best print-spooling fecilities, if use of a seriel printer iso't a drawback. (See the chart for a complete listing of usable prioter types.)

Overall, our tests were very enjoyahle. It was a real pleasure to use most of these networks. As we said before, they were, overall, surprisingly good. Oh, we have our complaints, hut they're mostly the result of immaturity io the marketplace. We anticipate, though, that the good ones will get better and that there will be some quick-and-dirty entries in the market, whose only claim will be low prica. Our advice: Assess your needs carefully, make your choices, and don't be afraid to pay for the capahilities you need. */PC*

Editor's note: *See olso "Getting hooked on PCnet," and "Getting the Net Working," in this issue.*

OUR purpose was to separate the smoke from the fire, and there is no doubt that there is a bit of each in networking.

Product Information

For list prices of the products, see chart.

Omninet
Corvus Systems, Inc.
2029 O'Toole Ave.
San Jose, CA 95131
(408) 946-7700

CIRCLE 548 ON READER SERVICE CARD

Plan 4000
Nestar Systems, Inc.
2582 East Bayshore Rd.
Palo Alto, CA 94303
(415) 493-2233

CIRCLE 547 ON READER SERVICE CARD

EtherSeries
3Com Corporation
1390 Shorebird Way
P.O. Box 7390
Mountein View, CA 94039
(415) 961-9602

CIRCLE 546 ON READER SERVICE CARD

Elen
Tecmar, inc.
8225 Cochran Rd.
Soloo, OH 44139
(216) 349-0600

CIRCLE 545 ON READER SERVICE CARD

Shareoet X and S
Novell, Inc.
1170 North industrial Perk Dr.
Orem, UT 84057
(801) 226-8202

CIRCLE 543 ON READER SERVICE CARD

PCnet
Orcbid Technology
47790 Westinghouse Dr.
Fremont, CA 94539
(415) 490-8586

CIRCLE 542 ON READER SERVICE CARD